

Madera Irrigation District (Stebbins *et al.* 1995, California Natural Diversity Data Base 2003), and (5) the small population in San Joaquin County that is on land used for educational purposes by the University of California Cooperative Extension (California Natural Diversity Data Base 2003).

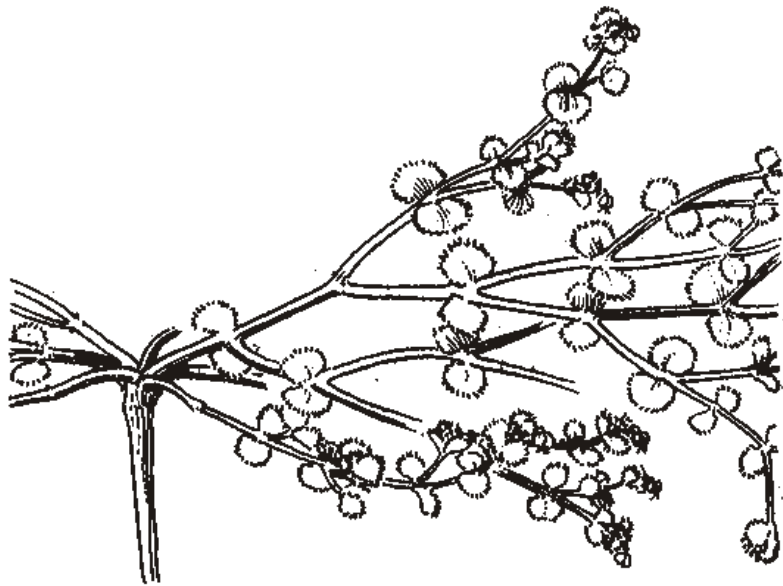
## 2. *CHAMAESYCE HOOVERI* (HOOVER'S SPURGE)

### a. Description and Taxonomy

**Taxonomy.**—Hoover's spurge is a member of the spurge family (Euphorbiaceae). This plant was originally named *Euphorbia hooveri*, based on a specimen collected by Hoover in Yettam, Tulare County (Wheeler 1940). At that time, the genus *Euphorbia* was viewed as comprising several subgenera, including *Chamaesyce* and *Euphorbia*. Webster (1975) subsequently elevated the subgenus *Chamaesyce* to the rank of genus based on growth patterns and physiology. The currently accepted scientific name, *Chamaesyce hooveri*, was validated when Koutnik (1985) published the new combination.

Several other species of *Chamaesyce* have ranges similar to that of *Chamaesyce hooveri* and may occur in the same habitats. *Chamaesyce ocellata* ssp. *ocellata* (yerba golondrina) is yellowish-green, has untoothed leaves, and lacks appendages on the glands. *Chamaesyce ocellata* ssp. *rattanii* (Stony Creek spurge) has hairy stems and leaves and the gland appendages are entire. *Chamaesyce serpyllifolia* (thyme-leaved spurge) also has entire appendages and further differs from *C. hooveri* in microscopic characters of the female flower (Wheeler 1941, Munz and Keck 1959, Koutnik 1993).

**Description and Identification.**—*Chamaesyce hooveri* (**Figure II-3**) trails along the ground, forming gray-green mats 5 to 100 centimeters (2.0 to 39.4 inches) in diameter (Broyles 1987, Stone *et al.* 1988). The stems are hairless and contain milky sap. The tiny (2 to 5 millimeter [0.08 to 0.20 inch]) leaves are opposite, rounded to kidney-shaped, with an asymmetric base and a toothed margin. In the genus *Chamaesyce*, the structures that appear to be flowers actually are groups of flowers; each group is referred to as a cyathium. The cyathium in *C. hooveri* consists of a tiny, cup-like structure 2 millimeters (0.08 inch) in diameter containing five clusters of male flowers and a single female flower. None of the flowers have petals, but instead have white appendages on the edge of the cup that resemble petals. Each appendage is divided into from three to five finger-like projections about 1 millimeter (0.04 inch) long. The appendages are attached to four reddish glands situated along the margin of the cup. The tiny, white seeds are contained in a spherical capsule 2 millimeters (0.08 inch) in



**Figure II-3.** Illustration of *Chamaesyce hooveri* (Hoover's spurge). Reprinted with permission from Abrams (1951), *Illustrated Flora of the Pacific States: Washington, Oregon, and California*, Vol. III. © Stanford University Press.

diameter on a stalk that hangs over the edge of the cup. One cyathium is located between each pair of leaves (Wheeler 1941, Munz and Keck 1959, Koutnik 1993). The chromosome number of this taxon has not been determined.

## **b. Historical and Current Distribution**

***Historical Distribution.***—For decades, *Chamaesyce hooveri* was known from only three localities: near Yettem and Visalia in Tulare County, and near Vina in Tehama County. Collections were made from these three areas in the late 1930s and early 1940s (Wheeler 1941, Munz and Keck 1959, Stone *et al.* 1988). From 1974 through 1987, 21 additional occurrences of *C. hooveri* were reported. The majority of these (15) were in Tehama County. One to three occurrences were discovered during this period in each of Butte, Merced, Stanislaus, and Tulare Counties (Stone *et al.* 1988). The historical localities for this species were in the Northeastern Sacramento Valley, San Joaquin Valley, Solano-Colusa, and Southern Sierra Foothills Vernal Pool Regions (Keeler-Wolf *et al.* 1998) (Figure II-4).

***Current Distribution.***—Through August 2005, the California Natural Diversity Data Base (2005) listed 30 occurrences of *Chamaesyce hooveri*. In addition to these historical records, six occurrences were discovered in 1992 (three each in Glenn and Tulare Counties). Of the 30 California Natural Diversity Data Base (2003) occurrences, one each in Tehama and Tulare Counties are classified as extirpated; two others, in Butte and Tehama Counties, are “possibly extirpated” because this species was not observed for 2 consecutive years (Stone *et al.* 1988, California Natural Diversity Data Base 2003). Of the 26 occurrences presumed to be extant, only 3 have been observed within the past decade (California Natural Diversity Data Base 2003).

The main remaining area of concentration for *Chamaesyce hooveri* is within the Northeastern Sacramento Valley Vernal Pool Region. The Vina Plains of Tehama and Butte Counties contain 14 (53.8 percent) of the 26 known extant occurrences for *C. hooveri* (California Natural Diversity Data Base 2003) in an area of about 91 square kilometers (35 square miles; Stone *et al.* 1988). One other site in the same region is near Chico in Butte County. Seven of the extant occurrences are in the Southern Sierra Foothills Vernal Pool Region, including five in the Visalia-Yettem area of Tulare County and two in the Hickman-La Grange area of Stanislaus County. Three other occurrences are on the Sacramento National Wildlife Refuge in Glenn County, which is in the

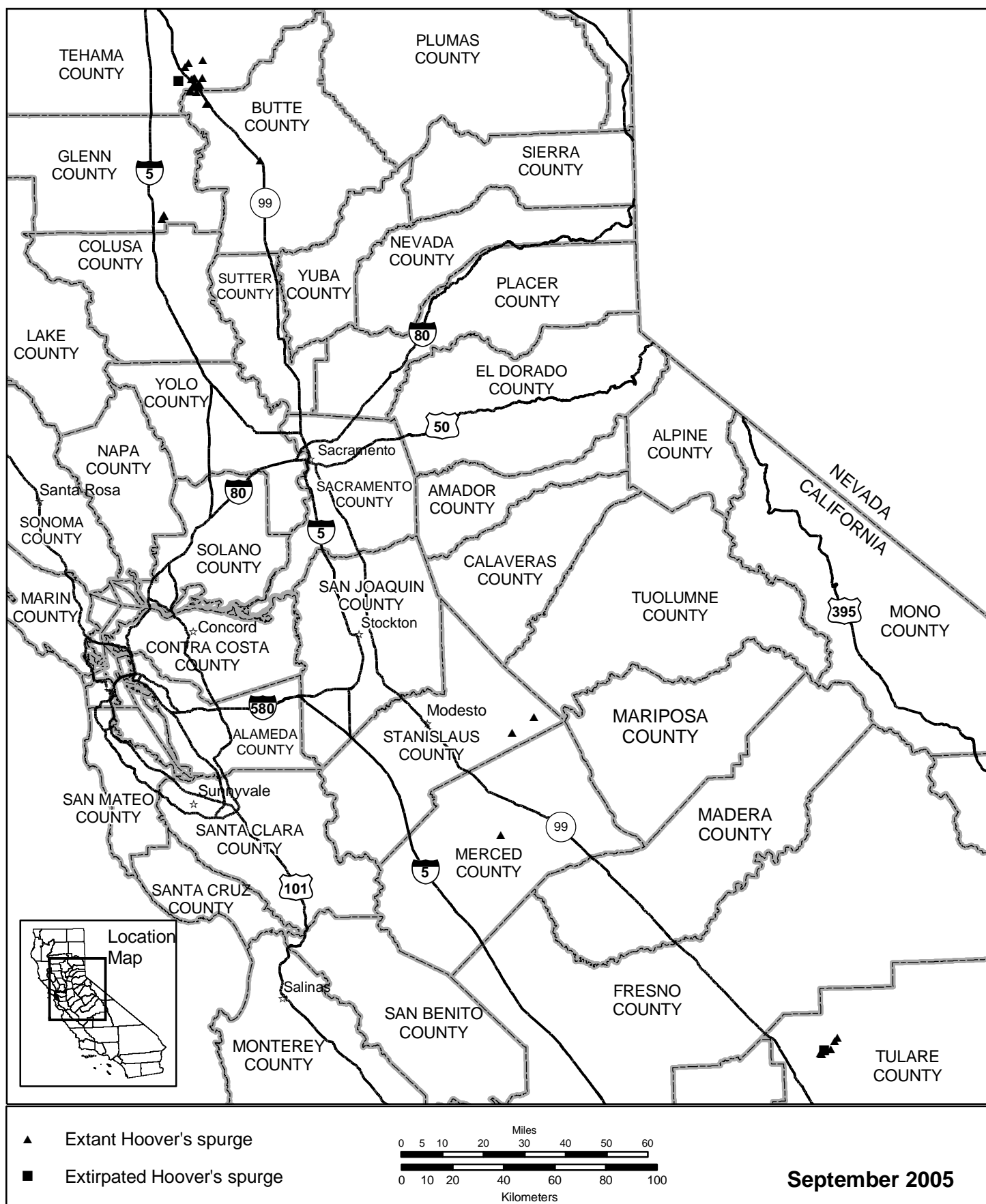


Figure II-4. Distribution of *Chamaesyce hooveri* (Hoover's spurge).

Solano-Colusa Vernal Pool Region. The one other extant occurrence is on the Bert Crane Ranch in Merced County, which is within the San Joaquin Valley Vernal Pool Region (Keeler-Wolf *et al.* 1998, California Natural Diversity Data Base 2003).

### **c. Life History and Habitat**

***Reproduction and Demography.***—*Chamaesyce hooveri* is a summer annual, but few details of its life history are known. Seeds of *C. hooveri* germinate after water evaporates from the pools; the plants cannot grow in standing water (Alexander and Schlising 1997). The indeterminate growth pattern allows the plants to continue growing as long as sufficient moisture is available. The proportion of seedlings surviving to reproduction has not been documented; in years of below-normal rainfall, seedling survival was characterized as “low” (Stone *et al.* 1988). Phenology varies among years and among sites, even for those populations in close proximity (Stone *et al.* 1988). Populations in Merced and Tulare Counties typically flower from late May through July, whereas those farther north in Stanislaus County and the Sacramento Valley flower from mid-June into October (Alexander and Schlising 1997, J. Silveira *in litt.* 2000, California Natural Diversity Data Base 2003). Seed set apparently begins soon after flowering. Seed production has not been quantified or studied in relation to environmental factors, but Stone *et al.* (1988) reported that large plants may produce several hundred seeds.

Demographic data suggest that seeds of *Chamaesyce hooveri* can remain dormant until the appropriate temperature and moisture conditions occur. This dormancy is evident from the fact that plants can be absent from a given pool for up to 4 years and then reappear in substantial numbers (Stone *et al.* 1988).

Beetles (order Coleoptera), flies (order Diptera), bees and wasps (order Hymenoptera), and butterflies and moths (order Lepidoptera) have been observed visiting the flowers of *Chamaesyce hooveri* and may potentially serve as pollinators (Stone *et al.* 1988, Alexander and Schlising 1997). Related species in the spurge family are pollinated by flies (Heywood 1978). Also, the glands on the cyathium produce nectar (Wheeler 1941), which is attractive to insects. Related species in the genus *Euphorbia* typically are cross-pollinated because the female flowers on each plant mature before the male (Heywood 1978), which may or may not be the case for *C. hooveri*.

***Habitat and Community Associations.***—*Chamaesyce hooveri* is restricted to vernal pools (Stone *et al.* 1988, Koutnik 1993, Skinner and Pavlik 1994). However, the plant appears to adapted to a wide variety of soils, which range in

texture from clay to sandy loam. Specific soil series from which it has been reported include Anita, Laniger, Lewis, Madera, Meikle, Riz, Tuscan, Whitney, and Willows.

Natural pools in which the plant occurs are primarily classified as Northern Hardpan and Northern Claypan vernal pools (Sawyer and Keeler-Wolf 1995). In the Northeastern Sacramento Valley Vernal Pool Region, occupied pools are generally on acidic soils over iron-silica cemented hardpan. Most pools supporting *Chamaesyce hooveri* in the San Joaquin Valley, Solano-Colusa, and Southern Sierra Foothills vernal pool regions are on neutral to saline-alkaline soils over lime-silica cemented hardpan or claypan (Broyles 1987, Stone *et al.* 1988, Sawyer and Keeler-Wolf 1995, California Natural Diversity Data Base 2003).

Vernal pools supporting *Chamaesyce hooveri* typically occur on alluvial fans or terraces of ancient rivers or streams, with a few on the rim of the Central Valley basin. In addition, *C. hooveri* has been reported from several pools that were formed artificially when small ponds were created in appropriate soil types (California Natural Diversity Data Base 2003).

The pools supporting this species vary in size from 0.19 to 243 hectares (0.47 to 600 acres), with a median area of 0.58 hectare (1.43 acres) (Stone *et al.* 1988). This species may occur along the margins or in the deepest portions of the dried pool-bed (Stone *et al.* 1988, Alexander and Schlising 1997). Deeper pools apparently provide better habitat for this species because the duration of inundation is longer and the deeper portions are nearly devoid of other vegetation, thus limiting competition from other plants (J. Stebbins *in litt.* 2000a, Stone *et al.* 1988).

Throughout its range, two of the most frequent associates of *Chamaesyce hooveri* are the rare vernal pool grasses *Tuctoria greenei* and *Orcuttia pilosa*. However, *Chamaesyce hooveri* does tend to grow in different portions of the pools than these grasses (Stone *et al.* 1988, Alexander and Schlising 1997). Other plants addressed in this recovery plan that grow with *Chamaesyce hooveri* are *Atriplex persistens*, *Eryngium spinosepalum*, *Neostapfia colusana*, *Orcuttia inaequalis*, *Astragalus tener* var. *ferrisiae*, and *Gratiola heterosepala* (Oswald and Silveira 1995, Alexander and Schlising 1997, California Natural Diversity Data Base 2005). In the Vina Plains, other common associates of *Chamaesyce hooveri* are *Marsilea vestita* (water shamrock), *Eryngium castrense* (common coyote-thistle), *Convolvulus arvensis* (bindweed), and *Amaranthus albus* (white tumbleweed) (Alexander and Schlising 1997). In Glenn, Merced, and Tulare Counties, *Cressa truxillensis* (alkali weed), *Distichlis spicata* (saltgrass), *Frankenia salina* (frankenian), *Grindelia camporum* (Great Valley gumplant), and other plants

tolerant of saline-alkali soils are typical associates of *Chamaesyce hooveri* (Stone *et al.* 1988, J. Silveira *in litt.* 2000, California Natural Diversity Data Base 2005).

#### **d. Reasons for Decline and Threats to Survival**

Most species addressed in this recovery plan are threatened by similar factors because they occupy the same vernal pool ecosystems. These general threats, faced by all the covered species, are discussed in greater detail in the Introduction section of this recovery plan. Additional, specific threats to *Chamaesyce hooveri* are described below.

Agricultural conversions (*i.e.*, from grasslands or pastures to croplands, or from one crop-type to another) are a continuing specific threat, particularly in Stanislaus County (Stone *et al.* 1988). Competition from invasive native and non-native plant species threatens nine of the extant occurrences, including eight in the Vina Plains and one on the Sacramento National Wildlife Refuge in Glenn County. Native competitors of *Chamaesyce hooveri* include *Eryngium* spp., *Malvella leprosa* (alkali mallow, a noxious weed according to Hill 1993), *Phyla nodiflora* (lippia), *Scirpus acutus* var. *occidentalis* (hard-stemmed tule), *Scirpus maritimus* (alkali bulrush), and *Xanthium strumarium* (cocklebur). Nonnative competitors include *Convolvulus arvensis* (a noxious weed according to Dempster 1993) and *Crypsis schoenoides* (swamp grass) (J. Silveira *in litt.* 2000, California Natural Diversity Data Base 2003). On the Vina Plains Preserve (in 1995), the pools with *Chamaesyce hooveri* also had the highest frequency of *Convolvulus arvensis* (Alexander and Schlising 1997). Increasing dominance by these competitors may be associated with changes in hydrology and livestock grazing practices (Stone *et al.* 1988, Alexander and Schlising 1997, California Natural Diversity Data Base 2003).

Five of the remaining occurrences of *Chamaesyce hooveri* are subject to specific hydrologic threats; four of the five are in the San Joaquin Valley and the fifth is in the Vina Plains. Hydrology has been altered by (1) construction of levees and other water barriers and (2) runoff from adjacent agricultural operations, roads, and culverts. Such impacts result in some pools receiving insufficient water, while others remain flooded for too long to allow growth of *C. hooveri*. Although no occurrences have been completely extirpated due to hydrologic changes, the species has been eliminated from one or more individual pools at several sites and a number of the remaining populations appear to be in decline (Stone *et al.* 1988, Stebbins *et al.* 1995, California Natural Diversity Data Base 2003).

Some specific threats also are continuing due to inappropriate livestock grazing practices. While livestock generally do not forage on *Chamaesyce hooveri*, because it grows very close to the ground and contains a toxic, milky sap

(Wheeler 1941, Stone *et al.* 1988), cattle trampling has nevertheless been identified as seriously reducing *C. hooveri* populations at one site each in Butte and Stanislaus Counties (Stone *et al.* 1988); relatively high livestock stocking rates such as often prevail during summer months could similarly damage this plant's populations at other locations.

The threat posed by small population size may also be a significant continuing factor. At least 5 of the known occurrences of this plant total fewer than 100 individuals in years of most-favorable conditions (California Natural Diversity Data Base 2003). Two other occurrences with populations of only a few hundred individuals also may be similarly threatened. Such small populations are subject to extirpation from random events, including extrinsic factors such as weather and intrinsic factors such as genetic drift (Shaffer 1981, Menges 1991).

Another specific threat is the potential lack of pollinators. However, because the specific insects that pollinate *Chamaesyce hooveri* have not yet been identified, assessment of their status and providing them with protection, if necessary, cannot yet be undertaken. If essential pollinators are declining through habitat loss, *C. hooveri* may be declining in response. Another very localized threat to *C. hooveri* on certain public and private lands is direct trampling, particularly in areas that receive high controlled human usage or vandalism activity (U.S. Fish and Wildlife Service 1997a).

#### **e. Conservation Efforts**

*Chamaesyce hooveri* was listed as a threatened species on March 26, 1997 (U.S. Fish and Wildlife Service 1997a). *Chamaesyce hooveri* is not listed under the California Endangered Species Act (California Department of Fish and Game 1999). The California Native Plant Society included *C. hooveri* on its first list of rare plants (Powell 1974); currently, *C. hooveri* is on List 1B and is considered to be "endangered in a portion of its range" (California Native Plant Society 2001). In 2005, critical habitat was designated for *C. hooveri* and several other vernal pool species in *Final Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants in California and Southern Oregon; Evaluation of Economic Exclusions From August 2003 Final Designation; Final Rule* (U.S. Fish and Wildlife Service 2005).

Ten occurrences of *Chamaesyce hooveri* are in preserves or on public land. The Vina Plains Preserve, managed by The Nature Conservancy, includes four of the extant occurrences and one presumed extirpated occurrence. The California Department of Fish and Game manages two of the extant Tulare County occurrences as part of the Stone Corral Ecological Reserve complex. Three of the extant occurrences are on the Sacramento National Wildlife Refuge (California



Natural Diversity Data Base 2003). The Sacramento National Wildlife Refuge populations have been monitored annually since 1992 (J. Silveira *in litt.* 2000). One additional occurrence of *C. hooveri* in Merced County is on private land (the Bert Crane Ranch) that is protected from development by a conservation easement (J. Silveira *in litt.* 2000).

We funded a status survey for *Chamaesyce hooveri* and other vernal pool plants in 1986 and 1987 (Stone *et al.* 1988), resulting in 10 new occurrences. We and the California Department of Fish and Game jointly funded an ecological study of the Vina Plains Preserve pools, which was conducted by faculty from California State University, Chico (Alexander and Schlising 1997). Independent surveys conducted by Joseph Silveira led to discovery of the Merced and Glenn county occurrences (J. Silveira *in litt.* 2000). Private landowners also have contributed to conservation of this species. One pool in Tehama County was fenced by the property owner in the late 1980s, to exclude livestock (Stone *et al.* 1988).

### **3. *ERYNGIUM CONSTANCEI* (LOCH LOMOND BUTTON-CELERY)**

#### **a. Description and Taxonomy**

***Taxonomy.***—Loch Lomond button-celery, specifically known as *Eryngium constancei* (Sheikh 1983), is a member of the carrot family (Apiaceae). This species was only recently described and therefore has no history of name changes. The common name was derived from the type locality, Loch Lomond, which is in Lake County (Sheikh 1983). Other common names for this species are Loch Lomond coyote-thistle (Skinner and Pavlik 1994) and Constance's coyote-thistle (Smith *et al.* 1980).

***Description and Identification.***—Certain features are common to species of the genus *Eryngium*. Unlike most vernal pool plants, *Eryngium* species are biennial or perennial, with an overwintering rootstock. The plant parts are often spiny, hence the word “thistle” in the common names. The earliest leaves produced from the rootstock each year are long and tubular with crosswise partitions. Leaves produced later in the growing season typically have a narrow petiole and a broader blade, which is usually lobed. *Eryngium* plants also have leaves at both the base of the plant and on the stem; stem leaves are typically opposite, but the upper leaves may be alternate. The tiny flowers are clustered into spiny heads. Individual fruits are small, dry, often scaly, and composed of two one-seeded, indehiscent units which separate at maturity and function as seeds.